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GASTRIC FUNCTION IN PULMONARY TUBERCULOSIS.[1]

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and

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The importance of a study of the gastric function in pulmonary tuberculosis can scarcely be overestimated when we consider the great frequency with which symptoms of disordered function occur, and particularly when we recall the important part which the digestion plays in the successful treatment of these patients. The frequency of gastric symptoms has been variously stated by different writers; thus Hutchinson, among the older observers, emphasized the frequency of dyspepsia as an early symptom, stating that it occurred in 92 per cent. of his cases, and in 55 per cent. was quite severe. More recent observers give lower percentages, thus, Janowsky 35 per cent., Levison 74.6 per cent., and Landis 55.3 per cent. In our own experience we found among 1000 consecutive patients with pulmonary tuberculosis in various stages that symptoms referable to the stomach were complained of in 64.6 per cent.

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[1] Read before the National Association for the Study and Prevention of Tuberculosis, Washington, D. C., May 12, 1916.

While gastric disturbances are very common, the symptoms produced are not entirely due to changes in the stomach peculiar to tuberculosis, but, as Landis pointed out, are such as might occur in any chronic wasting disease. It is also a mistake to designate these disorders as purely functional, since catarrhal inflammation is commonly associated. Organic lesions other than catarrhal inflammation, such as ulcer, cicatrical stenosis of pylorus, etc., are extremely rare. This is in striking contrast with the alimentary tract below the stomach, in which ulceration, particularly, is extremely common.

It is not the purpose of this paper to present a discussion of the pathological changes in the stomach, nevertheless, a brief summary of these changes will aid in the interpretation of the symptoms and disordered functions. We know practically nothing of the pathological anatomy of the stomach in early tuberculosis. In advanced lesions, however, autopsy reveals frequently a chronic catarrhal gastritis with some degree of dilatation. W. S. Fenwick states that it is rare to do an autopsy on these cases without encountering some increase in the dimensions of the organ. Among 100 cases in which a special note was made of the position of the lower margin it was found below the umbilicus in 64. He believes that the degree of gastrectasis bears a direct relation to the extent and chronicity of the pulmonary lesion. In 6 out of 7 cases of acute miliary infection no increase in the size of the stomach was observed. The histological changes in the stomach are largely those of chronic catarrhal inflammation. The studies of Marfan, Schwable, Fenwick and others confirm this view. Actual tuberculous lesions of the stomach are extremely rare; ulceration, the most common, occurring but twice in 2000 autopsies at the Brompton Hospital (Fenwick) and not once in 85 autopsies among our patients.

We have endeavored in the present study to investigate primarily the gastric function in early and advanced cases of tuberculosis, and having obtained this information, to correlate disordered function with disease and symptoms.

The studies of Rehfuss, Hawk, and Bergeim and their co-workers in the Jefferson Medical College and hospital have demonstrated the fallacy of the old-time method of estimating gastric function by a single analysis of a test meal withdrawn one hour after ingestion by the large stomach tube with an aspirating bulb. The impossibility of interpreting the findings by this method depends upon (1) the inadequacy of the tube, and (2) the fallacy of single one-hour examinations. Harmer and Dodd have shown by Roentgen-ray studies that the old stomach tube does not completely remove the gastric contents. It is objectionable to the patient, causes considerable gagging and swallowing of mucus, and cannot be retained in the stomach with any degree of comfort for any length of time. The tube which overcomes these objections is a smaller one of a diameter of 4 mm., which at one end has a perforated metal tip sufficiently heavy to pass by gravity into the stomach and its lowest portion. After insertion the tube may be left *in situ* as long as necessary until the whole phase of the gastric digestion has been studied. By this means small quantities (8 to 10 c.c.) of gastric contents can be withdrawn at fifteen-minute intervals after the ingestion of the test meal and examined. By this method, termed "fractional estimation," a "secretory curve" can be established of considerable value in determining the gastric functions.

Practically all the recorded studies of gastric function in pulmonary tuberculosis, notably those of Edinger, Brieger, Klemperer, Schetty, Hildebrandt, Einhorn, and Immerman, were made by the old method, and are, therefore, in the light of new methods, open to grave criticism as to their accuracy and their interpretation.

Einhorn found in 15 cases that normal acidity existed in 5, hyperacidity in 5, and diminished or absent acidity in 5 cases. Klemperer, Immerman, and Schetty found in early cases that the secretion was normal or somewhat increased. Brieger found in the early stages that the cases of normal and disturbed secretion were about evenly divided; in moderate cases normal in 33 per cent., reduced in 60 per cent., and absent in 6.6 per cent.; and in advanced cases, normal in 16 per cent., reduced in 74.4 per cent., and absent in 9.6 per cent. Van Valzah and Nisbet found in 65 per cent. of 73 comparatively early cases that the secretion of HCl. was normal or above at least part of the time. Croner studied 36 cases of early tuberculosis and found the total acidity varied from 21 to 80, except in 5 cases, which showed a complete failure; in most cases, however, it was normal. Hayem studied 80 cases; among the 32 incipient, 15 showed hyperacidity, 16 hypoacidity, and 2 apepsia. Among 48 advanced cases 15 showed hyperacidity and 33 hypoacidity. Reed, in his book on *Diseases of the Stomach and Intestines*, states that "it is now known that a large proportion of the cases of early phthisis—a preponderance of them according to some observers—has an excessive secretion of HCl."

Klemperer found that free HCl gradually disappeared as the pulmonary disease progressed, while Schetty could discover no marked alteration, and Immerman was able to find it even in advanced cases with fever. Hildebrandt believed that fever played an important role, since he found HCl absent in pyrexia and present in apyrexia.

The motor function of the stomach was studied by Immerman and Klemperer. The former found no changes, while the latter, using his oil method, found a marked enfeeblement. Einhorn found that the motor power of the stomach was not diminished to a very high degree, and Brieger states that when the secretion of HCl fails there is a diminution in motor power. King studied 26 cases and found in active incipient cases that the acidity and motility are increased; in inactive incipient cases no uniform disturbance other than that found in non-tuberculous individuals; in advanced cases, active and inactive, the tendency to a lowered acidity and motility. One of King's cases showed achylia gastrica. Munson, in 1905, concluded a very excellent review of the literature and a personal study with the statement that the small amount of hyperacidity in his series, its occurrence in early as well as late cases, the marked tendency to hypoacidity and its frequent transformation into anachlorhydria, and the undisturbed motor power made up the picture presented by his cases.

The lack of harmony must be perfectly evident, and is due, perhaps, to the inherent fallacies of the old method of study of the gastric functions which we discussed in the early part of this paper.

Rehfuss, Bergeim, and Hawk found that in normal individuals no specific curve could be constructed that would include all cases free from gastro-intestinal symptoms. It was possible, however, to classify them according to one of the following three types:

1. The "isosecretory" type (Chart I), which shows a steady rise expressed in terms of cubic centimeters of tenth normal sodium hydroxide, maximum 60, usually sustained from half an hour to one hour, and then a gradual decline with a total disappearance of the food rests in from two to two and a half hours.
2. The "hypersecretory" type (Chart II) shows a rapid response to stimuli, often a marked change in the acidity, rapid rise in the acidity high point from 70 to 100 or more, either abrupt or sustained, and a slow or no decline in the usual time. The test meal left the stomach in normal time, that is, from two to two and a half hours; but even after the passage of all material there was encountered an outpouring of pure gastric juice for a half hour, one hour, or even several hours. This finding was so common in symptomless cases that Rehfuss and his coworkers called it "continued" digestive secretion in contradistinction to hypersecretion, which is a distinct clinical entity with symptoms.
3. The "hyposecretory" type (Chart VI) is similar to the first type, but there is usually a slower ascent, slower response to

stimuli, and a high point from 40 to 50. Rehfuss encountered this type least frequently in normal subjects.

The patients studied in our series comprise 22 early and 25 advanced cases of pulmonary tuberculosis.[2] The early cases were dispensary patients and the advanced cases were in the hospital wards.

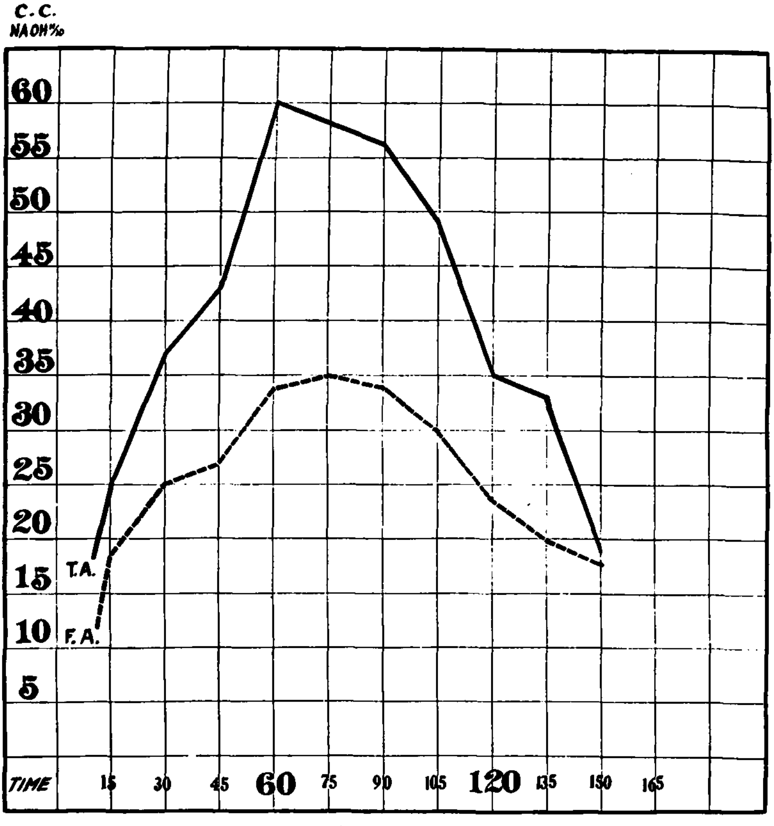

CHART I.—"Iso-secretory" type.

EARLY CASES. Among the 22 early cases observed, 11 complained of symptoms referable to the gastro-intestinal tract. Of this number 3 suffered with symptoms prior to and the remaining 8 subsequent to the development of cough, fever, etc., symptoms common in early lesions.

The gastric symptoms complained of in order of frequency were belching (which cannot be accounted for in every case by fermentation and was doubtless due to aërophagia), fulness and distress in the epigastrium, anorexia and vomiting.

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[2] The technic employed is described in Hawk's Practical Physiological Chemistry, 1916, 5th ed.

The high point of the total acidity (expressed in terms of the number of cubic centimeters of tenth normal sodium hydroxide required to neutralize 100 c.c. of gastric juice) was noted in

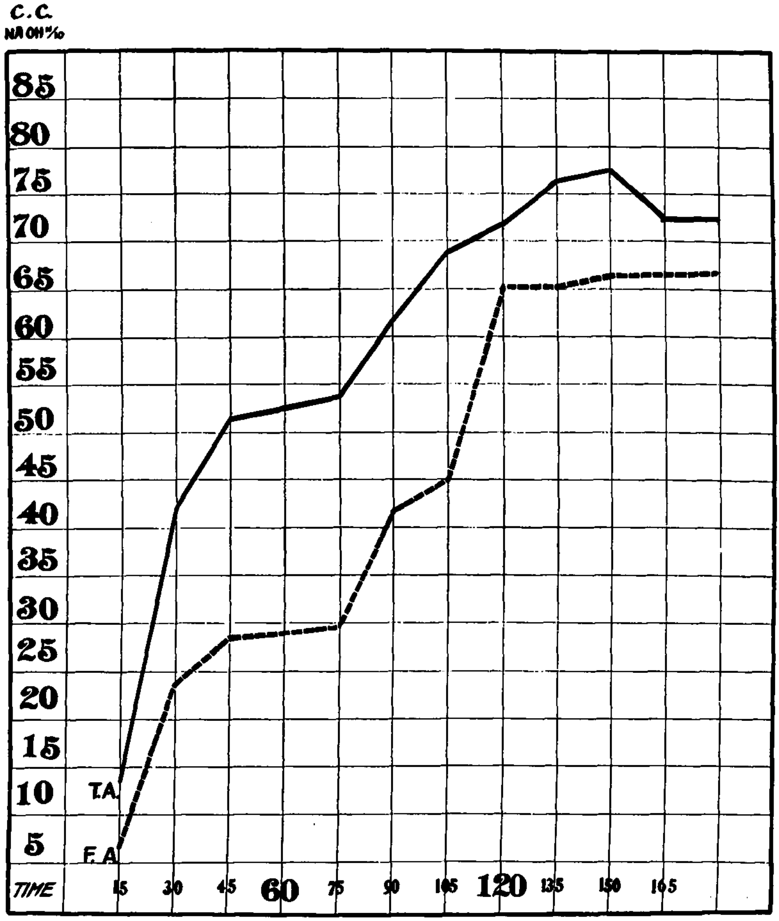

CHART II.—Hypersecretory type with continued digestive secretion; no symptoms.

6 cases at 1 hour
5 cases at 1¼ hours
4 cases at 1½ hours
3 cases at 2¼ hours
3 cases at 2½ hours
1 case at 2¾ hours

The high point of the free acidity (expressed in terms of the number of cubic centimeters of tenth normal sodium hydroxide required to neutralize 100 c.c. of gastric juice) was noted in

1 case at ¾ hour
4 cases at 1 hour
5 cases at 1¼ hours
2 cases at 1½ hours
2 cases at 1¾ hours
4 cases at 2¼ hours
3 cases at 2½ hours
1 case at 2¾ hours

It will be noted in the series of 22 early cases studied the high point of total acidity occurred at or before the one-and-a-quarter-hour period in 11 instances. Of these 11 cases, 3 presented gastric symptoms and 8 no symptoms. One may assume that where the high point occurs at the sixty-five or seventy-five-minute period, gastric symptoms are infrequent, provided the high point falls within the normal range of acidity. With regard to the 11 cases in which the high point of acidity occurred after the seventy-five-minute period, gastric symptoms were present in 7 instances and absent in 4; approximately a reversal of the former findings. The symptoms complained of in these cases occurred in the period preceding the high point. The explanation is that the symptoms are no doubt due to a delay and a deficiency in gastric function.

Nine of the 22 cases showed curves which revealed that after the Ewald test meal had left the stomach the secretion of gastric juice continued and the acidity remained high, as shown in Chart II, conforming with the "hypersecretory" type with "continued" digestive secretion.

After the administration of the Ewald meal, food rests were obtainable at the end of two and a half hours in 5 or 23 per cent. of the cases. We have been impressed by the lack of definite relation between gastric motility and gastric secretion. Case 19 (Chart III) of our series of early cases presents a curve of acidity with hypermotility in which the Ewald meal left the stomach at the end of seventy-five minutes and the patient did not complain of symptoms referable to the gastro-intestinal tract. Abderhalden and Meyer have shown active pepsin in all parts of the small intestine. This observation, coupled with the action of trypsin in the intestines, may account for the lack of symptoms noted in this case. On the other hand, in Case 20 (Chart IV), which type of curve conforms to the "hypersecretory" with "continued" digestive secretion, the high point of total acidity reached 124 at the one-hundred-and-fifty-minute period and presented no gastro-intestinal symptoms, while, at the same time, considerable remains of the Ewald meal were recovered.

Our observations have shown us that in patients presenting one of the normal types of secretory curves it does not necessarily follow that they possess normal appetites, but it is true that it is rare to note the reverse, that is, a normal appetite in patients exhibiting distinct pathological secretory curves. That the psychic element plays an important role in the creation of appetites of patients is very evident. Seven cases showed an excessive amount of mucus in one or more specimens or in the residuum. This condition occurred in patients complaining of gastro-intestinal symptoms. Lactic acid was present during the first hour in 9 cases. Bile was noted in the morning residuum of 6 patients. Free and total acidity were present in greater or lesser amounts in all the morning residuums. The peptic activity in early cases was not studied. No case of true hyperacidity with symptoms was encountered in the study of this series of early cases.

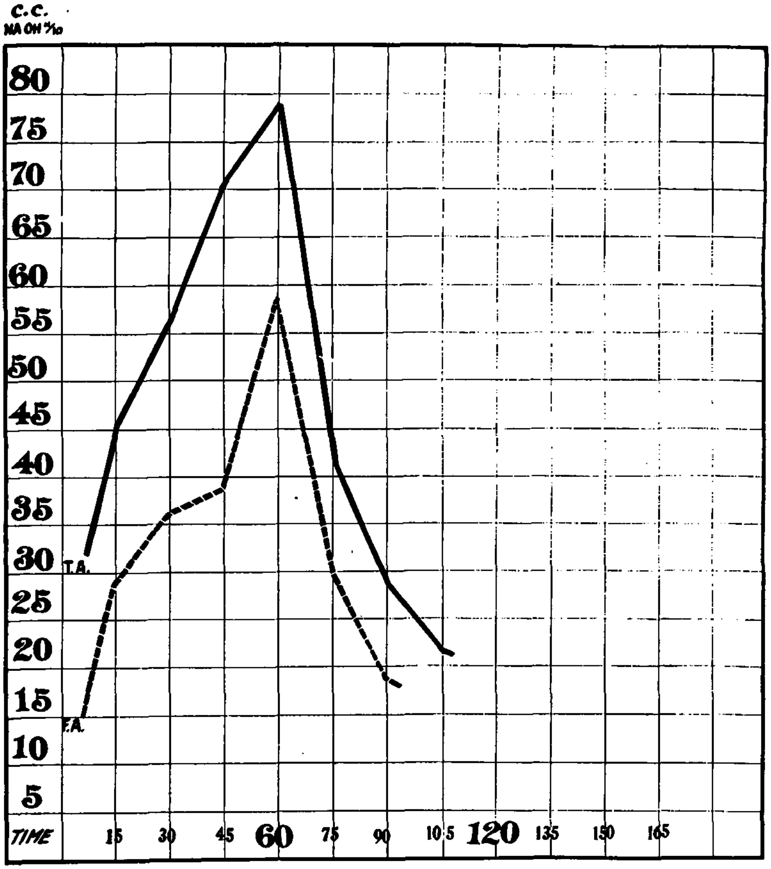

CHART III.—Hypermotility; absence of food rests after 1¼-hour period; no symptoms.

Advanced Cases. In a series of 25 advanced cases of pulmonary tuberculosis, 24 patients complained of gastro-intestinal symptoms. The morning residuum revealed the presence of mucus, bacteria, and leukocytes in excessive amounts in 20 of the cases. The tubercle bacillus was present in the residuum in 18 cases.

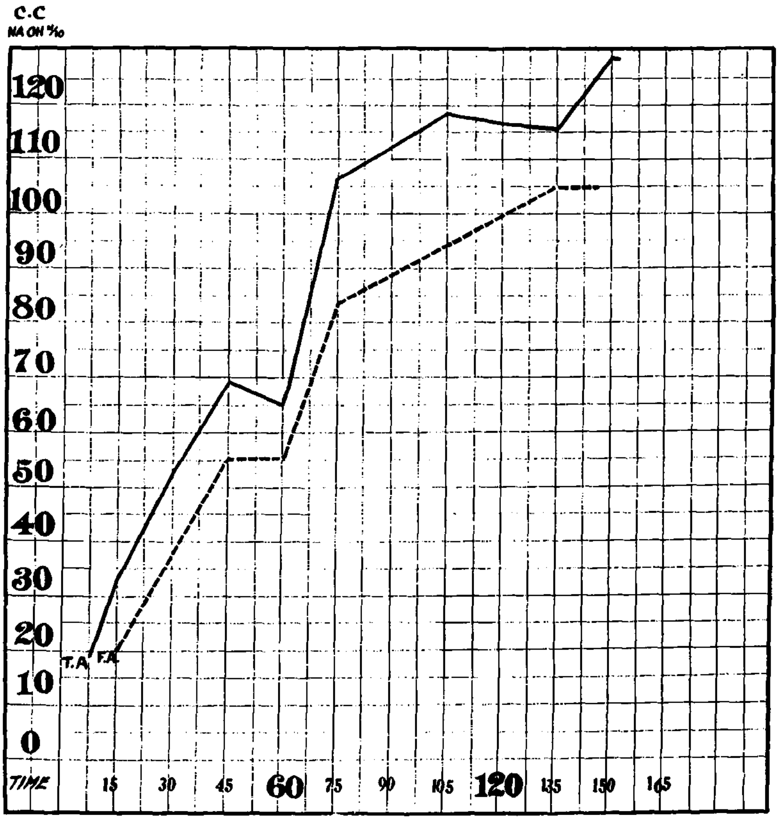

Chart IV.—Hyperacid type with continued digestive secretion; food rests at 2½-hour period-hypomotility; no symptoms,

The time of the occurrence of the high point of total acidity in this series was noted as follows:

1 case at ¾ hour
7 cases at 1 hour
3 cases at 1¼ hours
3 cases at 1½ hours
6 cases at 1¾ hours
5 cases at 2 hours

The high point in free acidity was noted as follows:

1 case at ¾ hour
5 cases at 1 hour
4 cases at 1¼ hours
5 hours at 1½ hours.
4 cases at 1¾ hours
6 cases at 2 hours

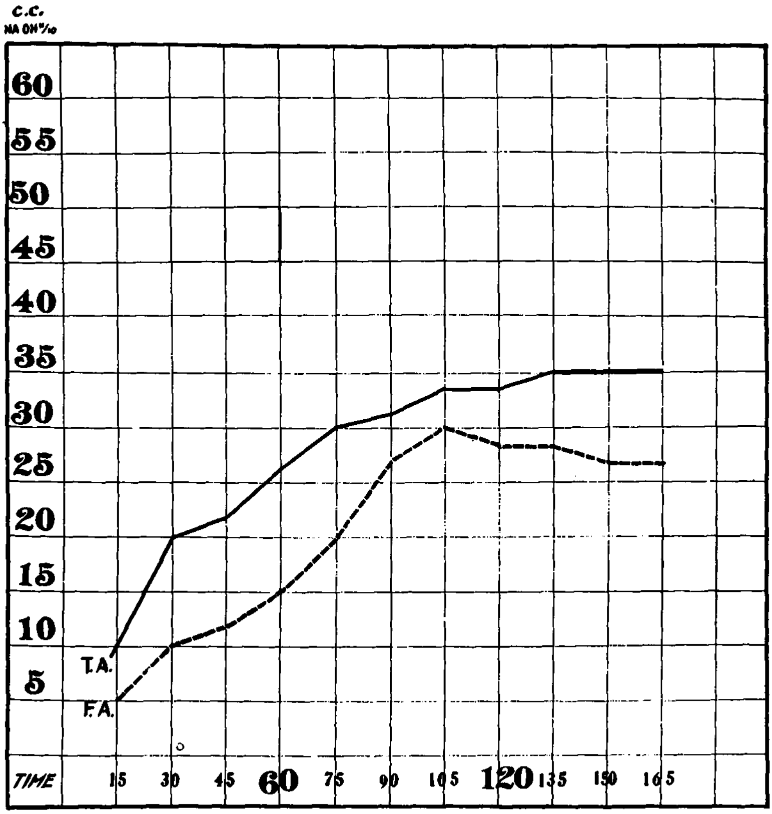

CHART V.—Typical curve showing delayed high point of acidity with continued secretion.

Fifteen of the advanced cases showed a slow ascent of curve with a late high point and continuation of the secretion rather than a decline, thereby resulting in delayed gastric digestion, as illustrated in Chart V.

After the administration of the Ewald meal food rests were obtainable at the end of two and a half hours in 18, or 72 per cent. of the cases, suggesting the greater frequency of delayed motility in the advanced cases as compared with early cases.

In 8 cases the curve conforms to the hyposecretory type, that is, a slow ascent to a high point which is sustained a half to three-quarters of an hour and then a gradual decline, as represented in Chart VI. The high point for total acidity in this group of cases averaged 24, and for free acidity 20, distinctly below the normal.

In one case we found a type of curve (Chart VII) representing psychic achylia in which the total acidity ranged from two at fifteen minutes to five at the end of one hour, with a total absence of free acid and peptic activity. Following this period the total acidity and free acidity rapidly rose to 40 and 32 respectively. Gastro-intestinal symptoms were very prominent in this case during the first hour following the taking of food. This case represents a type which by the older methods of gastric analysis would have been interpreted a case of true achylia gastrica rather than what we now know to be pseudo-achylia.

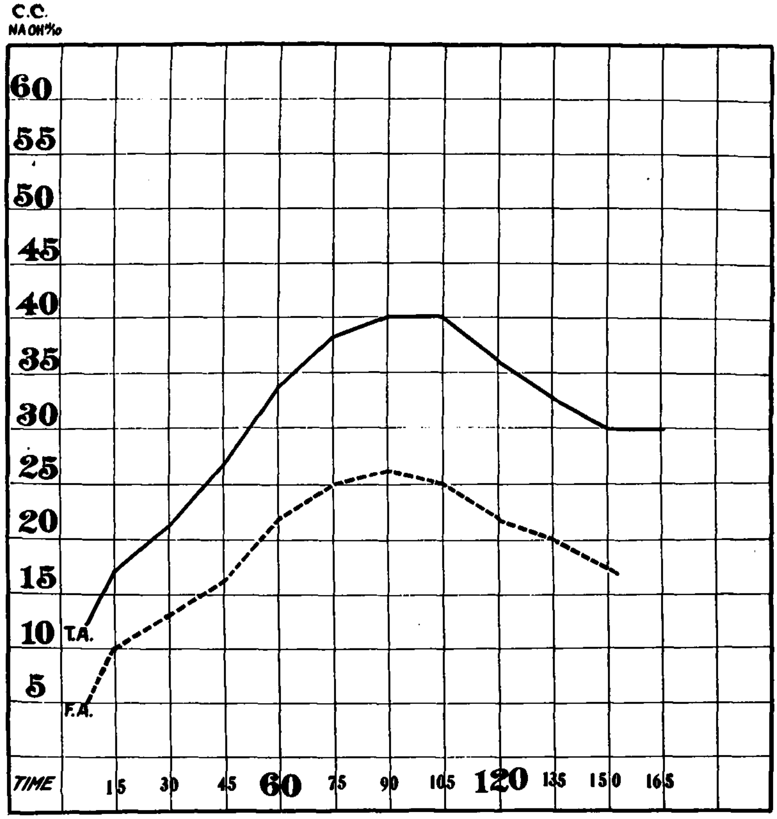

CHART VI.—Type of curve "hyposecretory" noted in 8 cases.

Only one case in this series of advanced cases—in fact, only one in the entire 47 cases of early and advanced—illustrates a type of "hypersecretory" curve with symptoms of hyperacidity, as shown in Chart VIII.

In the study of the peptic activity in 8 cases of advanced pulmonary tuberculosis it was noted that when the total acidity was low and slow in ascent the pepsin curve conformed to the acidity curve.

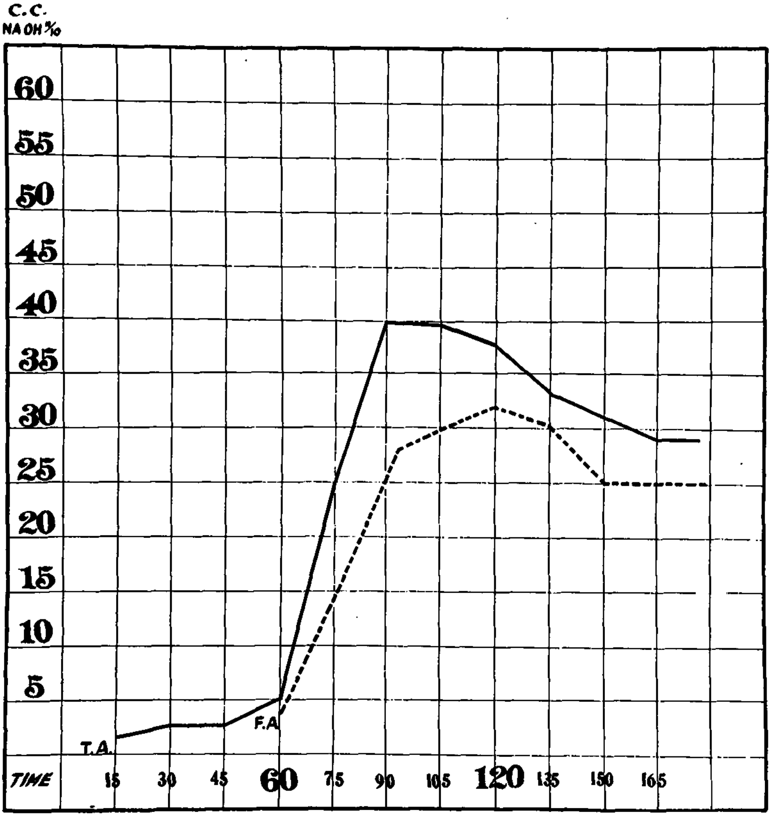

CHART VII.—Psychic achylia gastrica.

CONCLUSIONS. From a study of the early and advanced cases under observation we conclude:

1. That pulmonary tuberculosis causes a definite downward progression in both the motility and the secretory function of the stomach from the very beginning of the disease.

2. That hyperacidity with symptoms occurring in early stages and described by previous writers as common is quite rare. That even hyperacidity without symptoms is rare—the type which corresponds to the normal "hypersecretory curve" of Rehfuss

existing in 40 to 50 per cent. of normal individuals (Rehfuss) exists considerably less frequently in early tuberculous patients. This would indicate that even in early tuberculous patients, changes in gastric functions are present.

3. That the so-called "pretubercular dyspepsias" of previous writers are misnamed and that we believe they are in reality manifestations associated with definite tuberculous infection.

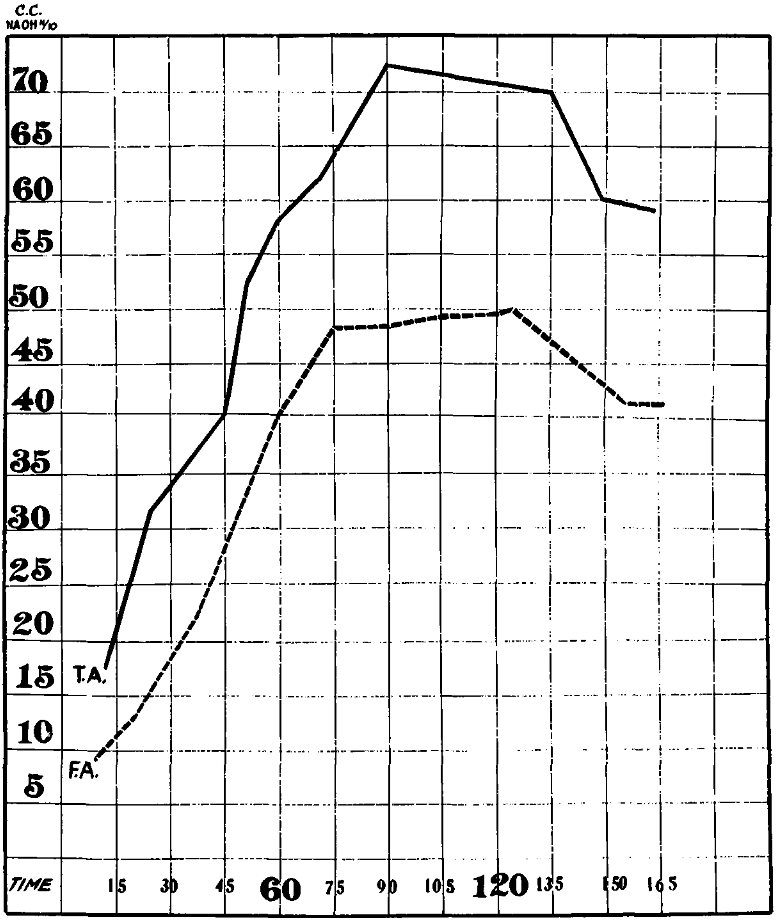

CHART VIII.—"Hypersecretory" type with symptoms of hyperacidity.

4. That we do not believe, on the basis of our studies, that there is an "irritative stage" giving hyperacidity in early tuberculosis. Our studies suggest that the gastric disorder is the result of disease of the gastric mucosa.

5. That there is a distinct tendency toward the formation of a definite clinical syndrome known as delayed digestion which becomes more and more associated with symptoms as the disease progresses.
6. We believe with Einhorn that the swallowing of tuberculous sputum plays a highly important role in the continuation and aggravation of disordered function. No less important are the visceroptosis and gastrectasis.
7. That the fractional estimation with the development of secretory curves is at present the most accurate method of studying the gastric function.

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INJURIES TO THE PERIPHERAL NERVES PRODUCED BY MODERN WARFARE.[1]

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THE injuries to the nervous system which I shall describe are based upon ten months' observations at the American Ambulance Hospital at Neuilly sur Seine, and upon impressions gained by

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[1] Read before the joint meeting of the New York Neurological Society and the Section on Neurology and Psychiatry of the New York Academy of Medicine.